Oxford Cambridge and RSA

GCE

Mathematics

Unit **4722**: Core Mathematics 2

Advanced Subsidiary GCE

Mark Scheme for June 2017

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations and abbreviations

Annotation in scoris	**Meaning**
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
^	Omission sign
MR	Misread
NGE	Not good enough
BP	Blank page
Highlighting	
Other abbreviations in mark scheme	**Meaning**
E1	Mark for explaining
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working
cwo	Correct working only

Subject-specific Marking Instructions for GCE Mathematics Pure strand

a Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded

b An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

c The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d When a part of a question has two or more ‘method’ steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation ‘dep *’ is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be ‘follow through’. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

g Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

h For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A or B mark in the question.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

Question			Answer	Marks	Guidance	
1	(i)		$(2\sqrt{7})^2 = x^2 + (x+2)^2 - 2x(x+2)\cos 60$ $x^2 + 2x - 24 = 0$ $(x+6)(x-4) = 0$ $x = 4$	M1	Attempt use of correct cosine rule	Must be attempt to use correct rule but allow BOD on lack of brackets eg $2\sqrt{7}\ ^2$ not $(2\sqrt{7})^2$, even if subsequently 14, and the same for the terms involving x Allow omission of a square sign when substituting as long as correct formula has been seen No need to evaluate cos60 for M1 Evaluating in radian mode (-0.952) still can get M1 as long as cos60 seen first
				A1	Obtain correct 3 term quadratic	Must be simplified to three terms but not necessarily all on one side of the equation
				M1	Attempt to solve 3 term quadratic equation	See additional guidance for valid methods
				A1	Obtain $x = 4$ only	Must be from a correct solution of a correct quadratic, though only the positive root may ever be seen Could draw attention to required root by giving both answers and then eg underlining $x = 4$ A0 if $x = -6$ still present
				[4]		If the other root is stated, before being discarded, it must have been $x = -6$
	(ii)		$\frac{1}{2} \times 4 \times 6 \times \sin 60$ $= 6\sqrt{3}$	M1	Attempt area of the triangle, using their x	Must be using correct formula, including $^1/_2$ Allow equiv methods, such as $^1/_2\, bh$ as long as valid attempt at b and h Must be using a positive, numerical, value of x from **(i)**
				A1	Obtain $6\sqrt{3}$	Must be given as simplified surd No ISW if then given as decimal, unless the exact value is indicated as the final answer (underlined etc)
				[2]		

Question			Answer	Marks	Guidance	
2	**(i)**		$0.5\times0.2\{\cos0 + \cos0.8 + 2(\cos0.2 + \cos0.4 + \cos0.6)\}$ $= 0.715$	B1	State the 5 correct y-values, and no others	B0 if other y-values also found (unless not used) Allow for exact values seen, even if subsequent error made (including evaluating in degree mode) Allow decimal equivs (2dp or better) (1, 0.980, 0.921, 0.825, 0.697); if using 2dp then allow 0.7 rather than 0.70 for final y value
				M1*	Attempt to find area between $x = 0$ and $x = 0.8$, using $k\{y_0 + y_n + 2(y_1 + ... + y_{n-1})\}$	Correct placing of y-values required y-values may not necessarily be correct, but must be from attempt at using correct x-values in $y = \cos x$ (in radian mode or degree mode) The 'big brackets' must be seen, or implied by later working Could be implied by stating general rule in terms of y_0 etc, as long as these have been attempted elsewhere and clearly labelled Could use other than 4 strips as long as of equal width (but M0 for just one strip)
				M1d*	Use $k = 0.5 \times 0.2$ soi	Or $k = 0.5 \times h$, where h is consistent with the number of strips used
				A1	Obtain 0.715, or better	Allow answers rounding to 0.715 if >3sf Using 4 separate trapezia can get full marks Must see evidence of trapezium rule or 0/4 (integration gives 0.717 to 3sf) Working in degrees: B1 if exact values seen (ie cos0.2 etc), but B0 if straight into decimals M1 M1 is then possible as long as it is clear where each value is being placed $0.5\times0.2\ \{1.00 + 1.00 + 2(1.00 + 1.00 + 1.00)\} = 0.800$ will be 0/4 unless more detail shown
				[4]		

Question			Answer	Marks	Guidance	
	(ii)		Graph of $y = \cos x$, with 4 trapezia drawn	B1	Correct $y = \cos x$ graph, with exactly 4 trapezia of roughly equal width	Trapezia must be plausibly [0, 0.8], allow BOD as long as final trapezium ends before $^{\pi}/_{2}$ Curve may be shown beyond $x = 0.8$, but B0 if clearly of the incorrect shape beyond $x = 0.8$ No need for scale on either axis Exactly four trapezia must be shown, of roughly equal widths, with top vertices on the curve.
			Tops of the trapezia are below the curve	B1 **[2]**	Any valid explanation	Not dependent on previous B1 Must refer to the tops of the trapezia so B0 for ‘trapezia are below curve’ (ie ‘top’ not used) Allow ‘trapezium’ rather than ‘trapezia’ Concave / convex is B0 B0 if comparing to exact area B1 for decreasing gradient (but B0 for decreasing curve) Candidates could also use their diagram as part of their explanation – as long as there was an intention to draw trapezia then they are eligible for the second B1 even if B0 for the diagram. This could include a single trapezium (even if labelled 0 – 0.8), several trapezia whose tops are collinear, an incorrect y = cosx graph (including y = sin$x$) and similar. Use of rectangles to support their explanation however is B0. They could shade gaps on their diagram but some text also required B0 for ‘some area not calculated’ unless clear which area - could be described or shaded ISW any irrelevant comments, but B0 if contradictory comments

Question			Answer	Marks	Guidance	
3	**(i)**		$1 + 4x + 7x^2 + 7x^3$	B1	Obtain $1 + 4x$	Must be 1, not 1^8 Must be $4x$ not unsimplified equiv Allow separate terms not linked by '+' eg 1, $4x$
				M1	Attempt at least one more term - product of correct binomial coeff and power of $^1/_2\,x$	Powers of $^1/_2\,x$ must be consistent with the binomial coeff being used Binomial coeff must be numerical, so $^8C_2$ is not yet sufficient Allow M1 if powers only applied to x and not ½
				A1	Obtain $7x^2$	Coeff must be simplified As part of sum, or part of list
				A1	Obtain $7x^3$	Coeff must be simplified As part of sum, or part of list ISW any attempt to 'simplify' **If expanding brackets:** Mark as above, but must consider all 8 brackets for the M mark (allow irrelevant terms to be discarded)
				[4]		
	(ii)		$4(y + y^2) + 7(y + y^2)^2$ Hence coefficient of y^2 is 11	M1	Attempt to use $x = y + y^2$ in their expansion from **(i)**	Replace x with $y + y^2$ in both relevant terms and attempt expansion, including relevant numerical coeffs from **(i)** Allow M1 if using their attempt at a 'simplified' expansion Could instead attempt a new expansion - must use correct binomial coeffs and powers of $^1/_2(y + y^2)$
				A1FT	Obtain coefficient of 11 (or $11y^2$), FT their **(i)**	Ignore terms involving powers other than y^2 The FT is on their $1 + 4x + 7x^2 + 7x^3$, not a multiple of this as a result of any attempt to 'simplify'
				[2]		

Question			Answer	Marks	Guidance	
4			$\frac{dy}{dx} = 5x^{\frac{3}{2}} - 10x$	B1	Expand bracket to obtain correct expression	Each term must be of form kx^n, so $5x\sqrt{x}$ is not sufficient
			$y = 2x^{\frac{5}{2}} - 5x^2 + c$	M1	Attempt integration	M0 if bracket not expanded first M1 can still be gained for integrating an incorrect expansion as long as there are two terms For an 'integration attempt' there must be an increase in power by 1 for both terms
			$11 = 64 - 80 + c \Rightarrow c = 27$	A1	Obtain at least one correct term	Allow unsimplified coeffs
			$y = 2x^{\frac{5}{2}} - 5x^2 + 27$	A1	Obtain fully correct expression (allow no $+c$)	Allow unsimplified coeffs
				M1	Attempt to find c, using (4, 11)	There must have been a clear attempt at integration, but can follow M0 eg if the bracket was not expanded first Need to get as far as actually attempting c M1 could be implied by eg 11 = 64 - 80 followed by an attempt to include a constant to balance the equation M0 if no + c seen or implied M0 for $x = 11$, $y = 4$ Allow a slip when substituting, as long as it is clear that use of $x = 4$, $y = 11$ is intended
				A1 **[6]**	Obtain fully correct equation, including $y = ...$	Coefficients now need to be simplified Must be an equation ie $y = ...$, so A0 for 'f(x) = ...' or 'equation = ...' ISW an incorrect attempt to further simplify the equation NB this question can also be done using integration by parts – 4/4 for correct integral (but no partial credit) and then M1A1 as per MS

Question			Answer	Marks	Guidance	
5			$r\theta = 6$ $½r^2\theta = 24$ $½r \times 6 = 24$ $r = 8$, $\theta = 0.75$ segment area = $24 - ½ \times 8^2 \times \sin 0.75$ $= 2.19$	B1*	State $r\theta = 6$	Or exact equiv from using a fraction of the circle
				B1*	State $½r^2\theta = 24$	Or exact equiv from using a fraction of the circle Allow B1 for $^1/_2\, r \times \text{arc} = 24$ Stating both $½r^2\theta = 24$ and $^1/_2 r^2\sin\theta = 24$ is B0 unless only the correct equation is subsequently used B1 B1 can be implied by a correct equation in a single variable
				M1d*	Attempt to solve simultaneously to find r or θ	As far as attempting r or θ, using a valid method (but allow slips) Must be using the two correct equations in r and θ
				A1	Obtain $r = 8$, $\theta = 0.75$ (aef)	Both values required
				M1	Attempt area of segment	24 – area of triangle, using $^1/_2 r^2\sin\theta$ or equiv Allow if evaluated in degree mode (gives 23.58) Allow M1 for attempting $^1/_2 r^2(\theta - \sin\theta)$ with their r and θ, even if this does not give area of sector as 24
				A1	Obtain 2.19, or better	Allow final answer in range [2.187, 2.188] if > 3sf Could use variables other than r and θ
				[6]		**Alt method for working in degrees** B1 - state $^{\theta}/_{360} \times 2\pi r = 6$ B1 - state $^{\theta}/_{360} \times \pi r^2 = 24$ M1 - attempt to solve simultaneously A1 - obtain $r = 8$, $\theta = 43.0^\circ$ or better (42.97...) M1 - attempt area of segment NB using $^1/_2 r^2(\theta - \sin\theta)$ with θ in degrees is M0 as incorrect attempt at area of sector A1 - obtain 2.19 or better

Question			Answer	Marks	Guidance	
6			$\int(11 - x - 2x^2)\mathrm{d}x = 11x - \frac{1}{2}x^2 - \frac{2}{3}x^3$ $\int 8x^{-3}\mathrm{d}x = -4x^{-2}$	M1	Attempt integration of $11 - x - 2x^2$	Increase in power by 1 for at least 2 terms
				A1	Obtain $11x - {}^1/_2\,x^2 - {}^2/_3\,x^3$	Obtain correct integral
			$(22 - 2 - {}^{16}/_3) - (11 - {}^1/_2 - {}^2/_3) = {}^{29}/_6$	M1	Attempt integration of $8x^{-3}$	Integrate to kx^{-2}
			$(-1) - (-4) = 3$	A1	Obtain $-4x^{-2}$	Allow unsimplified coeff
			${}^{29}/_6 - 3 = {}^{11}/_6$	M1	Use limits of $x = 1, 2$	In both integrals Must follow clear attempt at integration Must be F(2) – F(1) ie correct order and subtraction
				M1	Attempt correct method to find shaded area (at any point)	M0 if incorrect order of subtraction, even if ${}^{11}/_6$ subsequently appears as final answer M1 can follow M0 for use of limits
				A1	Obtain ${}^{11}/_6$, or exact equiv	A0 for decimal answer unless clearly a recurring decimal (but not eg 1.833...) ISW if ${}^{11}/_6$ seen but then followed by eg 1.83
				[7]		Answer only is 0/7 - need to see evidence of integration, but use of limits does not need to be explicit **Alternative MS for subtracting first:** M1 - attempt subtraction in correct order M1 - attempt integration of $\pm(11 - x - 2x^2)$ A1 - obtain $\pm(11x - {}^1/_2\,x^2 - {}^2/_3\,x^3)$, signs must be consistent with their subtraction M1 - attempt integration of $\pm 8x^{-3}$ A1 - obtain $\mp 4x^{-2}$, sign must be consistent with their subtraction M1 - correct use of limits in entire integral A1 - obtain ${}^{11}/_6$

Question			Answer	Marks	Guidance	
						Ignore sight of $11 - x - 2x^2 = 8x^{-3}$ prior to subtraction occurring Adding functions prior to integration will get max of 5 marks - M0M1A1M1A1M1A0 (**Alt MS**) – to give same credit as integrating separately, using limits and then adding Multiplying through by x^3 prior to integration can get M1 for use of limits, and possibly M1 if subtraction happens before multiplying through
7	**(a)**		$(x + 1)\log 3 = 500\log 2$ $x + 1 = 315.46$ $x = 314$	M1	Introduce logs and drop power(s)	Any base (or no explicit base) as long as consistent If using logs to any base other than 2 or 3, then both powers must be dropped Allow BOD if $x + 1$ is not in brackets
				A1	Obtain correct linear equation	aef eg $x + 1 = 500\log_3 2$ Brackets must now be explicit, or implied by a later correct equation
				M1	Attempt to find x	Correct order of operations and correct operations, so M0 for eg $x = 500\log_3 2 + 1$
				A1	Obtain 314, or better	Allow answer in range [314.4, 314.5] if > 3sf ISW subsequent incorrect rounding once more accurate answer has been seen
				[4]		Answer only, or T&I, is 0/4 Writing 2 as $3^{0.6309}$ with no evidence of use of logs to find the index is 0/4

Question			Answer	Marks	Guidance	
	(b)	(i)	$\log_2(y+1) - \log_2 2 = \log_2 x^2$	B1	$2\log_2 x = \log_2 x^2$	Used correctly at any point, even if equation is no longer fully correct Allow no base
			$\log_2(^{y+1}/_2) = \log_2 x^2$ $y + 1 = 2x^2$	M1	Correctly combine at least two log terms	Could be the 2 log terms in the given equation, or could involve $\log_2 2$ The terms being combined must be correct, even if an error has occurred elsewhere in the equation M0 for incorrect method eg $^{\log(y+1)}/_{\log 2}$ even if it then becomes $\log(^{y+1}/_2)$
			$y = 2x^2 - 1$ ie $a = 2$, $b = -1$	A1	Correct equation with at least two terms combined	Equation of form $\log_2 f(x, y) = k$ or $\log_2 f(y) = \log_2 g(x)$ Condone no base on the logs
				A1	Obtain $y = 2x^2 - 1$	Correct equation required, but no need for explicit statement of $a = 2$, $b = -1$
				[4]		
		(ii)	$y - 10x + 14 = 1$ $2x^2 - 1 - 10x + 14 = 1$	B1FT	Correct equation - www	State correct equation - aef not involving logs Allow FT on an incorrect equation from **(i)** if the substitution occurs before the log is removed ie B1FT is awarded for their $(ax^2 + b) - 10x + 14 = 1$
			$2x^2 - 10x + 12 = 0 \Rightarrow x^2 - 5x + 6 = 0$ $(x-2)(x-3) = 0$ $x = 2$, $x = 3$ $y = 7$, $y = 17$	M1*	Attempt to eliminate a variable	Using their $y - 10x + 14 = 1$ with their answer from **(i)**, which must be of the form $y = ax^2 + b$ oe, to obtain an equation in a single variable not involving logs M1 can still be awarded if the method to remove logs is not correct
				M1d*	Attempt to solve 3 term quadratic	See additional guidance for valid methods
				A1	Obtain both correct x,y pairs	Clear indication of which values are paired together - could be implied by eg $y = 2 \times 2^2 - 1 = 7$ A0 if $y = 2x^2 - 1$ was obtained fortuitously in part **(i)**
				[4]		

Question			Answer	Marks	Guidance	
8	(a)		$a + 6d = 2(a + 4d)$ $a = -2d$ $^7/_2(2a + 6d) = 84$ $^7/_2(2a - 3a) = 84$ $a = -24$	M1	Attempt $u_7 = 2u_5$	Using correct $u_n = a + (n-1)d$
				A1	Obtain $a = -2d$ or equiv	Obtain correct simplified equation, with like terms combined
				B1	State $^7/_2(2a + 6d) = 84$	Or equiv, including unsimplified
				M1	Attempt to solve simultaneously	As far as attempting a or d Must be solving two equations in a and d, from attempt at $u_7 = 2u_5$ and attempt at S_7 (but could be from incorrect formulae eg $u_n = a + nd$)
				A1	Obtain $a = -24$	If d is also given then it must be correct ($d = 12$)
				[5]		Could use variables other than a and d

Question			Answer	Marks	Guidance	
	(b)		$r^2 = 2$ hence $r = \sqrt{2}$	B1	State $r = \sqrt{2}$ www	B0 if from $ar^7 = 2ar^5$ (but then allow all of the remaining marks) Allow decimal value (1.41) Allow B1 for $r = \pm\sqrt{2}$
			$\frac{a(1-\sqrt{2}^7)}{1-\sqrt{2}} = 254$	M1	Attempt $S_7 = 254$	Must be correct formula, using their numerical r, which could be exact or a decimal value Must also equate to 254
			$a = \frac{254(1-\sqrt{2})}{1-8\sqrt{2}}$	A1	Rearrange to obtain correct numerical expression for a aef	Must be in an exact form, but could involve $(\sqrt{2})^7$ or $\sqrt{128}$ rather than $8\sqrt{2}$ Ignore second value for a from using $r = -\sqrt{2}$
			$a = \frac{254(1-\sqrt{2})(1+8\sqrt{2})}{(1-8\sqrt{2})(1+8\sqrt{2})}$	B1	Use $(\sqrt{2})^7 = 8\sqrt{2}$ soi	Equation may no longer be fully correct
			$a = \frac{254(-15+7\sqrt{2})}{-127}$	M1	Attempt to rationalise denominator	Must be using $r = \sqrt{2}$ only Must be explicit evidence of rationalising Could use $(1 + (\sqrt{2})^7)$ or $(1 + \sqrt{128})$ Allow M1 if denominator now incorrect, as long as of form $\pm(1 - k\sqrt{2})$ or equiv M0 if rationalising $1 - \sqrt{2}$ only (ie before making a the subject)
			$a = 30 - 14\sqrt{2}$	A1	Obtain correct value in surd form	Allow any exact answer in form $p + q\sqrt{r}$ A0 if additional answer from using $r = -\sqrt{2}$ A0 if final answer results from subsequent attempt to simplify eg $a = 15 - 7\sqrt{2}$ (ie no ISW)
				[6]		Could use variables other than a and r If $a = 30 - 14\sqrt{2}$ obtained, but no evidence of dealing with $(\sqrt{2})^7$ or rationalising denominator then maximum of B1 M1 A1 ie 3 marks (as the given form has not been 'shown')

Question				Answer	Marks	Guidance	
9	(i)			$f(^1/_2) = {}^1/_2 + {}^9/_2 - 5 = 0$ $f(x) = (2x-1)(2x^2 + x + 5)$	B1	Confirm $f(^1/_2) = 0$, with detail shown	$4(^1/_2)^3 + 9(^1/_2) - 5 = 0$ is sufficient B0 for just $f(^1/_2) = 0$ No conclusion needed If using division to justify then must draw attention to the zero remainder
					M1	Attempt complete division or equiv	Must be dividing by $(2x-1)$ Must be complete method - ie all 3 terms attempted Long division - must subtract lower line (allow one slip) Inspection - expansion must give at least three correct terms of the cubic Coefficient matching - must be valid attempt at all coeffs of quadratic, considering all relevant terms each time Synthetic division - must be using 0.5 (not -0.5) and adding within each column (allow one slip); expect to see $\begin{array}{c\|cccc} 0.5 & 4 & 0 & 9 & -5 \\ & & 2 & 1 & \\ \hline & 4 & 2 & 10 & \end{array}$
					A1	Obtain correct quotient	Allow $4x^2 + 2x + 10$ from dividing by $x - {}^1/_2$
					A1	Obtain $(2x-1)(2x^2 + x + 5)$	Must be written as a product Allow $(x - {}^1/_2)(4x^2 + 2x + 10)$ ISW any attempt to write as 3 linear factors, or to find roots
					[4]		

Question			Answer	Marks	Guidance	
	(ii)	(a)	$4\sin 2\theta\cos 2\theta + \frac{5}{\cos 2\theta} = \frac{13\sin 2\theta}{\cos 2\theta}$	B1	Use $\tan 2\theta = \frac{\sin 2\theta}{\cos 2\theta}$ or $\tan 2\theta\cos 2\theta = \sin 2\theta$	Must be explicit, and correct notation when used Allow even if errors elsewhere in equation
			$4\sin 2\theta\cos^2 2\theta + 5 = 13\sin 2\theta$ $4\sin 2\theta(1 - \sin^2 2\theta) + 5 = 13\sin 2\theta$	B1	Correct method to remove fraction(s)	Any correct equation seen no longer containing fractions (allow recovery from a slip in notation)
			$4\sin 2\theta - 4\sin^3 2\theta + 5 = 13\sin 2\theta$	B1	Use $\cos^2 2\theta = 1 - \sin^2 2\theta$	Must be explicit, and correct notation when used Allow even if errors elsewhere in equation
			$4\sin^3 2\theta + 9\sin 2\theta - 5 = 0$	B1	Obtain correct equation, from correct working	Must be correct notation throughout Dependent on B1 B1 B1 awarded
				[4]		**NB - must annotate answer space at top of pg12**
		(b)	$(2\sin 2\theta - 1)(2\sin^2 2\theta + \sin 2\theta + 5) = 0$ $\sin 2\theta = {}^1/_2$	B1	State that $\sin 2\theta = {}^1/_2$ oe	Could just be stated, or implied by later method
			$2\theta = \frac{1}{6}\pi,\ \frac{5}{6}\pi, \frac{13}{6}\pi, \frac{17}{6}\pi$	M1	Attempt to solve $\sin 2\theta = \pm\,{}^1/_2$ to find at least one root	Correct order of operations ie ${}^1/_2$ ($\sin^{-1}\,{}^1/_2$) Allow M1 if angle(s) found in degrees (15^o, 75^o etc)
			$\theta = \frac{1}{12}\pi,\ \frac{5}{12}\pi, \frac{13}{12}\pi, \frac{17}{12}\pi$	A1	Obtain at least 2 correct roots	Must be in radians, and given in an exact form Allow recurring decimals, or mixed numbers
				A1	Obtain 4 correct roots	Must be in radians, and given in an exact form Allow recurring decimals, or mixed numbers ISW any angles that come from an incorrect quadratic quotient, or an incorrect attempt to find the roots of the quadratic quotient A0 if any extras in range [0, 2π] that are not clearly from their quadratic roots
				[4]		

APPENDIX 1

APPENDIX 1

Guidance for marking C2

Accuracy
Allow answers to 3sf or better, unless an integer is specified or clearly required.
Answers to 2 sf are penalised, unless stated otherwise in the mark scheme.
'3sf' is sometimes explicitly specified in a question - this is telling candidates that a decimal is required rather than an exact answer eg in logs, and more than 3sf should not be penalised unless stated in mark scheme.
If more than 3sf are given, allow the marks for an answer that falls within the guidance given in the mark scheme, with no obvious errors.

Extra solutions
Candidates will usually be penalised if any extra, incorrect, solutions are given. However, in trigonometry questions, only look at solutions in the given range and ignore any others, correct or incorrect.

Solving equations
With simultaneous equations, the method mark is given for eliminating one variable. Any valid method is allowed, such as balancing or substitution.

Solving quadratic equations
Factorising - candidates must get as far as factorising into two brackets which, on expansion, would give the correct coefficient of x^2 and at least one of the other two coefficients. This method is only credited if it is possible to factorise the quadratic – if the roots are surds then candidates are expected to use either the quadratic formula or complete the square.
Completing the square - candidates must get as far as $(x + p) = \pm \sqrt{q}$, with reasonable attempts at p and q.
Using the formula - candidates need to substitute values into the formula, with some attempt at evaluation (eg calculating $4ac$). The correct formula must be seen, either algebraic or numerical. If the algebraic formula is quoted then candidates are allowed to make one slip when substituting their values. The division line must extend under the entire numerator (seen or implied by later working). Condone not dividing by $2a$ as long as it has been seen earlier.

Solutions with no method shown
If a correct equation is seen, then the correct answers will imply that the method is correct – unless specified otherwise in the mark scheme, all answers to the equation must be given. So, if solving a quadratic, only the correct two roots will imply a correct method (NB on this paper the MS does identify an exception to this rule on Q1).
If an incorrect equation is seen, and no supporting method for solving it is shown, then examiners must not try to deduce the method used from the solutions provided.

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